Data Mining Lab, Exercise 2

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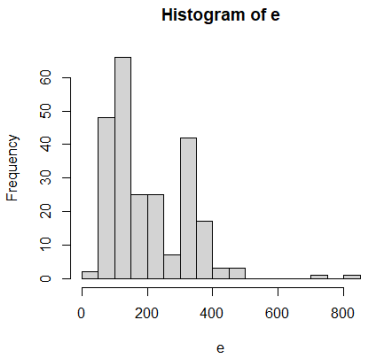
Dataset: cars 1.csv

Task# 1

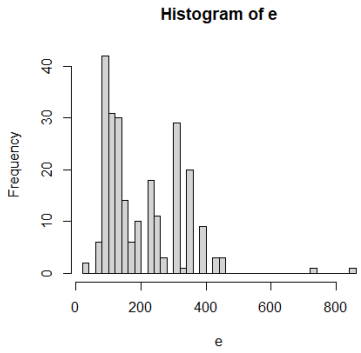
Identify the possible outliers using histograms and two-dimensional scatter plots.

```
d <- read.csv(file="cars 1.csv", header=TRUE, sep=",")
e <- d$engine.displacement
a <- d$acceleration
```

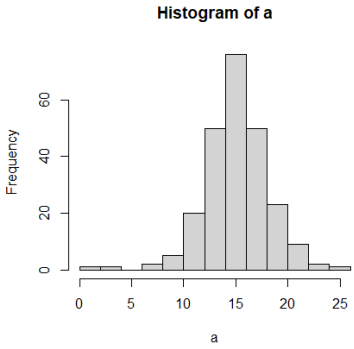
hist(e, breaks=15)



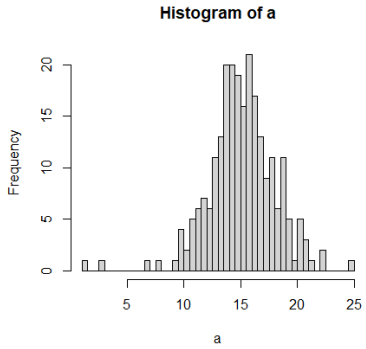
hist(e, breaks=50)



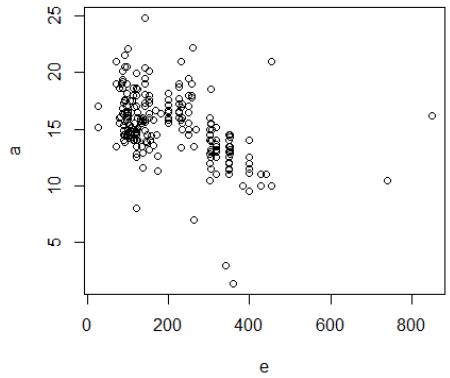
hist(a, breaks=15)



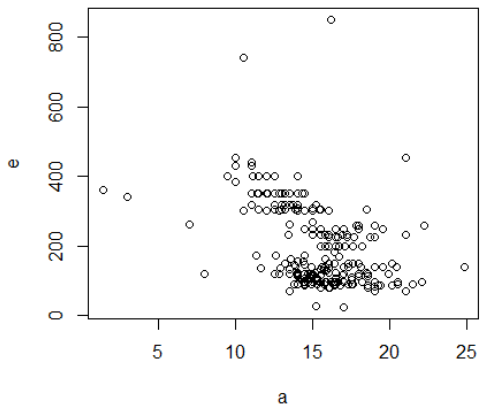
hist(a, breaks=50)



plot(e, a)



plot(a, e)



Values with e > 600(740, 850) and a < 5(3, 1.4) are the outliers. There are few more possible outliers that we need to check: a < 9(7, 8) and a > 24(24.8).

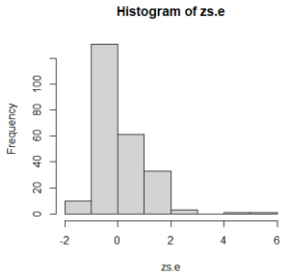
Task# 2

Verify that the values indicated in Task 1a and 1b are the outliers using:

a) The Z-score method

zs.e <- (e-mean(e))/sd(e)

hist(zs.e)



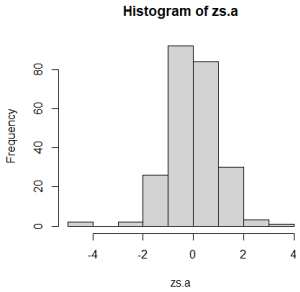
zs.e.outliers <- e[(zs.e < (-3)) | (zs.e > 3)]

[1] 740 850

Values 740 and 850 are outliers by the z-score.

zs.a <- (a-mean(a))/sd(a)

hist(zs.a)



zs.a.outliers <- a[(zs.a < (-3)) | (zs.a > 3)]

[1] 3.0 1.4 24.8

Values 3, 1.4 and 24.8 are outliers by the z-score.

b) The IQR method

*iqr.e.outliers <- e[(e < quantile(e,0.25) - 1.5*IQR(e)) | (e > quantile(e,0.75) + 1.5*IQR(e))]*

*iqr.a.outliers <- a[(a < quantile(a,0.25) - 1.5*IQR(a)) | (a > quantile(a,0.75) + 1.5*IQR(a))]*

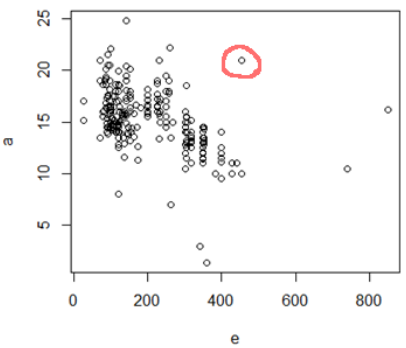
Values 740, 850, 3, 1.4, 22.1, 24.8, 22.2, 8 and 7 are outliers by the IQR method.

So, we can state that values 740, 850, 3 and 1.4 are verified outliers. Potential outlier 24.8 is confirmed. Potential outliers 7 and 8 are confirmed by the IQR method but not by Z-score method.

Task# 3

a) Which of the outliers detected by the numerical methods cannot be seen in the histogram and in the scatter plot?
- Values 22.1 and 22.2 outliers detected by the IQR method cannot be seen in the histogram and in the scatter plot.

b) Are there any outliers that can be clearly visible in the histogram or the scatter plot but are not indicated by the numerical methods?
- There is 1 value that is located at the maximum values of the range. There are no other values close to it, but it is not out of the range. So, this value cannot be detected by the IQR or Z-score methods. We need to check here number of values in the radius of the value. This method will show us that while value is in the range it is not intersecting with other values. So, most likely it is an outlier.



Task# 4

Investigate how the outliers affect the mean and median by doing the following:

a) Find the mean score and the median score with and without the outliers:

	e	a	e without outliers	a without outliers
Mean value	202.7063	15.23333	197.729	15.36936
Median value	151	15.2	151	15.2

b) State which measure, the mean or the median, the presence of the outliers affects more. Try to explain why.

Mean value is influenced by about 1.7%.
Median value is influenced by 0%.

Mean is calculated by taking the sum of the values and dividing with the number of values in a data series. Removing few values from the big datasets will have small effect. For small datasets, the impact can be significant.

The middle most value in a data series is called the median. Deleting an equal number of elements from the beginning and end of the dataset will have no effect. In other situations, the impact depends on the data.

In our example, the data has a low diversity. For example, sorted `a` has 7 values equal to 151 in a row. As a result, removing 2 values from one side of the set is not changing the median. Same for the `e`.

Summary: For the data provided in the `cars 1.csv` file, removing outliers has a larger effect on the mean.